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TITLE

A SYSTEM AND METHOD FOR MESSAGE TRANSPORT AND SEGMENTATION

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CROSS REFERENCE TO RELATED APPLICATION

Reference is made to U.S. Provisional Application for Patent Serial No. 60/104,929, filed on October 20, 1998, from which priority is claimed and which is hereby incorporated by reference in its entirety.

BACKGROUND OF THE INVENTION

Technical Field of the Invention

The present invention relates to networked communications systems, and in particular, to apparatus and methods operating within a communications network providing the ability to transport long messages via segmentation capability testing.

Description of Related Art

Within a communications network messages are passed between terminal points, which may also be characterized as nodal entities. The usual order of communication involves a message sent from a first node to a second node, and a response or reply to the initial message, sent back from the second node to the first node. For various reasons, such as the presence of excessive electronic noise or a physical fault in the network, the response may never reach the first node.

Timers have been built into network nodes to ensure that the failure to receive a response does not result in network inactivity for an indefinite period. That is, when a message is sent from one node to another, a timer within the sending node

is typically started and allowed to run for a preselected period of time. If no response is received before the timeout period (i.e., when the timer counts down to a value of zero), then the sending node is alerted to this fact and appropriate recovery measures can be taken.

One reason for the failure of nodes in a network to receive a response is the existence of increasingly sophisticated application software, which requires sending messages exceeding the limits established by current standards. For example, the Common Channel Signaling System No. 7 (SS7) standard is a global standard for telecommunications defined by the International Telecommunication Union Telecommunication Standardization Sector (ITU-T) and the American National Standards Institute, Committee T-1 (ANSI T-1). The SS7 standard defines procedures and protocol wherein network elements in the Public Switched Telephone Network (PSTN) exchange information over a digital signaling network to effect wireless (i.e., cellular) and wireline call set up, routing, and control. SS7 messages are exchanged between network elements, or nodes, over bidirectional channels called signaling links. The signaling points, or nodes, in an SS7 network comprise Service Switching Points (SSP), Service Transfer Points (STP), and Service Control Points (SCP).

The hardware and software functions of the SS7 protocol are divided into functional abstractions called "levels." These levels map loosely to the Open Systems Interconnect (OSI) seven-layer model defined by the International Standards Organization. The lowest level, or Message Transfer Part (MTP) is divided into three sub-levels. The lowest level, MTP Level 1, is equivalent to the OSI Physical Layer. MTP Level 1 defines the physical, electrical, and functional characteristics of a digital signaling link. The next level, MTP Level 2, insures accurate end-to-end

transmission of a message across the signaling link. Thus, MTP Level 2 implements flow control, message sequence validation, and error checking. MTP Level 2 is equivalent to the OSI Data Link Layer. Finally, MTP Level 3 provides message routing between signaling points in the SS7 network. MTP Level 3 re-routes traffic away from failed links and signaling points, and controls traffic when congestion occurs. MTP Level 3 is equivalent to the OSI Network Layer.

Within MTP Level 2, an SS7 message is called a Signal Unit (SU). There are three kinds of signal units: Fill-In Signal Units (FISUs), Link Status Signal Units (LSSUs), and Message Signal Units (MSUs). MSUs carry all network management, control, database query and response, and network maintenance data in the Signaling information Field (SIF). MSUs have a routing label which allows an originating signaling point to send information to a destination signaling point across the network. The SIF in an MSU contains the routing label and signaling information.

The Signaling Connection Control Part (SCCP) Level provides connectionless and connection-oriented network services and global title translation capabilities above MTP Level 3. The SCCP Level is loosely equivalent to the OSI transport layer. While MTP Level 3 provides point codes to allow messages to be addressed to specific signaling points, the SCCP provides subsystem numbers to allow messages to be addressed to specific applications (called subsystems) at the signaling points. The SCCP also provides the means by which an STP can perform global title translation, wherein the destination signaling point and subsystem number are determined from digits present in the signaling message. Because an STP provides global title translation, originating signaling points do not need to know the

destination point code or subsystem number of the associated service. Only the STPs need to maintain a database of destination point codes and subsystem numbers associated with specific services and possible destinations.

SCCP messages are contained within the Signaling Information Field (SIF) of an MSU. The SIF contains the routing label followed by the SCCP message content. The SCCP message is comprised of a one-octet message type field followed by the mandatory fixed-part, mandatory variable part, and an optional part. Each optional part parameter is identified by a one-octet parameter code followed by a length indicator (i.e., "octets to follow") field.

The Transaction Capabilities Applications Part (TCAP) Layer sits on top of the SCCP Level and supports the exchange of non-circuit related data between applications across the SS7 network. The SCCP is used as the transport layer for TCAP-based services. For example, in mobile networks, TCAP carries Mobile Application Part (MAP) messages sent between mobile switches and databases to support user authentication, equipment identification, and roaming.

The TCAP Layer enables the deployment of advanced intelligent network services by supporting non-circuit related information exchange between signaling points using the SCCP connectionless service. For example, an SSP uses the TCAP Layer to query an SCP to determine the routing numbers associated with a dialed "800" number. The SCP also uses the TCAP layer to return a response containing the routing numbers (or an error or reject component) back to the SSP. Similarly, when a mobile subscriber roams into a new Mobile Switching Center area, the integrated Visitor Location Register requests service profile information from the

subscriber's Home Location Register using MAP information carried within TCAP messages.

TCAP messages are contained within the SCCP portion of an MSU. A TCAP message comprises a transaction portion and a component portion. The transaction portion contains the package type identifier (e.g., query with permission, conversation with permission, etc.). The component portion contains components, such as Invoke (Last), Return Result (Last), Return Error, and Reject. Components include parameters containing application-specific data carried unexamined by TCAP Layer.

Since the Length Indicator (LI) portion of the MSU is limited to values between 0 and 63, a LI of 63 indicates that the message length is equal to or greater than 63 octets (up to a maximum of 272 octets). The maximum length of a signal unit is therefore 279 octets: 272 octets (data) + 1 octet (flag) + 1 octet (Backward Sequence Number + Backward Indicator Bit) + 1 octet (Forward Sequence Number + Forward Indicator Bit) + 1 octet (LI + 2 bits spare) + 1 octet (Service Information Octet) + 2 octets (Cyclic Redundancy Check). The problem addressed by the present invention arises when message data length exceeds the 272 octets allowed by a MSU.

Currently, for TCAP messages having lengths of greater than 272 characters (derived from an application operating within a signaling node), the SCCP Layer will act to divide the message data length into portions which are 272 octets long, or less. When the entire message data can be carried in a single MSU, the message is known as a Unitdata Message (UDT). When the message length is such

that multiple MSUs are required to transport the message, the individual MSUs are known as Extended Unitdata Messages (XUDTs).

Unfortunately, the SCCP Layer in older nodes does not provide a useful return result when presented with an XUDT message. For example, when a QUALREC message having more than 272 characters of message data is sent to an older SCCP node, no qualrec_return_result (or return_result or reject) message is returned to the sending node. Instead, such nodes discard XUDT messages. The application layer in the network is not aware of exactly why no return result message was obtained; the application is typically only able to indicate that there is a problem with the network communications. Thus, the failure to return a result may be characterized as a network noise problem, a hardware failure in the receiving node, or any number of other problems. The true cause of the error, which is the inability of the receiving node to properly process XUDT segmented messages provided by the SCCP, is not communicated to the sending node.

Therefore, what is needed, is a system and method supporting message transport and segmentation in a communications network having a plurality of nodes, wherein some of the nodes are capable of processing segmented messages, and other nodes are incapable of processing such messages. The system and method should be inexpensive to implement and relatively robust in operation. Further, the system and method should support testing and recordation of message segmentation and transport capability within the network.

Finally, a node supporting message transport and segmentation within a communications network is also needed. The node should have the capability of testing and recording the ability of other nodes to transport and segment long

messages. The system, method, and node of the present invention should all support message transport and segmentation using the OSI model, and more particularly, the SS7 protocol standard.

SUMMARY OF THE INVENTION

The present invention solves the foregoing problems arising from long messages passed between nodal entities which may not be capable of processing such messages by providing a node, a system, and a method for message transport and segmentation in a communications network. The node capable of supporting message transport and segmentation comprises a memory with a database for storing segmentation support capability test results. The memory includes a program module which sends segmentation support test messages to other nodes and receives segmentation support response messages. The program module is also capable of sending regular (non-test) segmented messages, and capable of receiving segmented messages.

The system of the present invention, capable of supporting message transport and segmentation in a communications network having a plurality of nodes, comprises a first node and a second node. The first node has a memory with a database for storing a plurality of segmentation support capability test results which are obtained when the first node sends a segmentation support test message and receives a segmentation support response message from the tested node (i.e., the second node). If the response message is received by the first node, indicating a positive result, then the tested node is capable of receiving segmented messages. If no response message is received, indicating a negative result, then the tested node is

not capable of receiving segmented messages. The second node is in electronic communication with the first node, is capable of receiving segmented messages, including segmentation support test messages, and is also capable of sending segmentation support response messages to the first node.

The nodes of the present invention may be SSPs, STPs, or SCPs. The segmented message sent between the nodes can be a SCCP message, which may, in turn, include a Segment Number field coded with a value indicating the number of segmented messages remaining to be received by the receiving node. The segmentation support test and response messages may be TCAP messages.

The method of the present invention, capable of supporting message transport and segmentation in a communications network having a plurality of nodes, comprises the steps of sending a segmentation support test message from a first node to a second node, sending a segmentation support response message from the second node to the first node, and sending a segmented message from the first node to the second node (when the segmentation support capability test result indicates that the second node is capable of receiving segmented messages). Typically, the method includes the step of recording the segmentation support capability result in a database contained in the memory in the first node. Of course, if the segmentation support capability test result indicates that the second node is not capable of receiving segmented messages, then only non-segmented messages will be sent from the first node to the second node thereafter.

The method of the present invention will also support sending a segmentation support test message from a first node to a second node, and setting a message reception timer located within the first node to count down while waiting for

a response from the second node. If no response message is received by the first (sending) node before the timer counts down to a value of zero, then only non-segmented messages will be sent from the first node to the second (receiving) node. In addition, the method includes the step of recording in the database that the second node is not capable of receiving segmented messages when the message reception timer counts down to a zero value over a preselected amount of time after waiting for receipt of a segmentation support response message.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete understanding of the method and apparatus of the present invention may be acquired by reference to the following Detailed Description when taken in conjunction with the accompanying drawings, wherein:

FIGURE 1 is a block diagram illustrating a network and node comprising the apparatus of the present invention;

FIGURE 2 is a block diagram illustrating the system of the present invention; and

FIGURE 3 is a signal flow and nodal operation diagram illustrating the method of the present invention.

DETAILED DESCRIPTION

Turning now to Fig. 1, a block diagram illustrating the node **20** comprising the apparatus of the present invention can be seen. Typically, a plurality of nodes **20**, **20'**, **70**, **80** and **90** are interconnected using signaling links **25** as part of a communications network **10**. For the purposes of describing the present invention, nodes **20**, **20'** are identical in capability (i.e., each of the nodes **20, 20'** is capable of

implementing the method of the present invention), but are physically or functionally distinct. Node **70** is capable of responding to segmented test messages from node **20**. Node **80** is incapable of responding to test messages, and will not support reception of segmented messages. The capability of node **90** is unknown for the purposes of illustrating the operation of the present invention.

The node **20** comprises a memory **30** including a database **40** for storing the results of testing by the node **20** within the network **10**. The node **20** maintains the database **40** by sending out segmentation support test messages to other nodes **20'** in the network **10** and waiting for receipt of segmentation support response messages indicating that the other nodes **20'** are capable of supporting receipt of segmented messages. In this case, a "segmented message" may be defined as some part of an integral message whose total length is longer than that permitted for transport as a whole by the protocol operating within the network **10**. For example, in the case of the SS7 protocol, the message character data length limit is 272 octets, or characters, and the integral message length (carried over several segmented messages) would therefore be 273 octets, or greater.

If the node **20'** receiving a segmentation support test message from the node **20** returns a segmentation support response message, indicating a positive test result, then the node **20** will record the positive result, marking node **20'** as capable of receiving segmented messages, in the database **40**. This positive result is generated and stored as one of a plurality of segmentation support capability test results **50**. The memory **30** also includes a program module **60** which is capable of sending and receiving segmented messages, segmentation support test messages, and segmentation support response messages.

A timer **75**, also known as a segmentation capability return result message reception timer **75**, is contained within the node **20**, and can be maintained as a part of the memory **30**. The timer **75** is used to count down to a value of zero from some preselected amount of time which begins whenever a segmentation support test message is sent to another node (e.g. node **80**), such that the node **20** may resume message transport activity even if no segmentation support response message is received by the node **20** from the tested node **80**. If such is the case, then the node **20** will assume that the node **80** is not capable of receiving segmented messages, and only non-segmented messages will be sent from the node **20** to the node **80** thereafter. The node **20** will act to generate and record in the database **40** an indication (i.e., a negative support capability test result) that the node **80** is not capable of receiving segmented messages.

The node **20** will typically search the database **40** to determine whether the destination node for any particular long message (e.g., an SCCP XUDT message) has the capability of receiving a segmented message. Thus, no time is wasted testing the destination node **20'** if the capability is already recorded in the database **40**.

The general functionality of the node **20** is equivalent to, or identical to, any number of different nodal entities commonly operating within communications networks. For example, the node may be a signaling point, such as an SSP, an STP, or an SCP; the node may also be a Home Location Register (HLR), a Visitor Location Register (VLR), or a Mobile Switching Center (MSC).

When implementing the invention using the SS7 protocol, the segmented messages may be SCCP messages, which include a Segment Number field Coded with a value indicating the number of segmented messages remaining to be

received by the node. The segmentation support test and response messages may be TCAP messages.

Turning now to Figure 2, a block diagram illustrating the system of the present invention capable of supporting message transport and segmentation in a communications network can be seen. The system comprises a first node **20** having a memory **30** which includes a database **40** for storing a plurality of segmentation support capability test results **50**. The node **20** may also comprise a program module **60** and a timer **75**, as described previously. The first node **20** is adapted to send a segmented message, including a segmentation support test message. The first node **20** is also adapted to receive a segmentation support response message, and to generate a segmentation support capability test result **77**.

The second node **20'** is in electronic communication with the first node **20** by way of a signaling link **25**. The second node **20'** is adapted to receive segmented messages and segmentation support test messages, and to send a segmentation support response message. In this case, if the first node **20** sends a segmentation support test message to the second node **20'**, then the generated segmentation support capability test result **77** will be positive, which indicates that the second node **20'** is capable of receiving segmented messages.

Turning now to Figure 3, a signal flow and nodal operation diagram illustrating the method of the present invention can be seen. As described and illustrated in Figure 1, the memory **30** of the first node **20** includes a database **50** for storing a plurality of segmentation support capability test results **77**. In this case, there are a plurality of nodes **20**, **20'**, **70**, **80**, and **90** within the communications

network **10**. The first node **20** comprises a memory and timer, and is identical to the node **20** described and illustrated in Figure 1.

The method begins by sending a first segmentation support test message **100** from the first node **20** to the second node **20'**. The method continues with the step of sending a segmentation support response message **110** from the second node **20'** to the first node **20** in response to receiving the first segmentation support test message **100**. Receiving the segmentation support response message **110** results in generating a positive segmentation support capability test result **115**, which signifies that the second node **20'** is capable of receiving segmented messages. Typically, the method continues by including the step of recording the positive segmentation support capability test result **115** in the database of node **20** at step **120**, and the method concludes with sending a segmented message from the first node **20** to the second node **20'** at step **130**.

After a node **20'** is tested, and its capabilities are recorded in the database of node **20**, the testing sequence may thereafter be obviated by searching the database within the node **20** to determine whether the node **20'** has been tested, and if so, whether it is capable of receiving segmented messages at step **220**.

The method of the present invention may also include the steps of sending a segmentation support test message **140** from the first node **20** to a third node **70**. If the third node **70** is incapable of supporting message segmentation, then a segmentation support response message **150** will not be received by the first node **20**, which results in generating a negative segmentation support capability test result **117**. In fact, no segmentation support response message **150** at all is sent from the third node **70** to the first node **20**. In this case, the negative segmentation support

capability test result **117** generated by the node **20** indicates that the third node **70** is not capable of receiving segmented messages. The negative result **117** may then be recorded in the database of node **20** at step **160**. Thereafter, nonsegmented messages will be sent from the first node **20** to the third node **70**, shown at step **170**. Again, once the message segmentation support capability of the third node **70** is known and recorded within the database of node **20**, the steps of testing for message segmentation support may be obviated by implementing a search of the database at step **220** to determine before testing whether the third node **70** is capable of receiving segmented messages.

Another embodiment of the method of the present invention makes use of a timer **75** within the node **20**. In response to sending a segmentation support test message at step **180** to the node **80** from the node **20**, the timer **75** within the node **20** counts down to value of zero at step **190**. No segmentation support response message is received from the node **80**. Typically, a negative segmentation support capability test result **118** will be generated and recorded at step **200** in the database of the node **20**, indicating that the node **80** is not capable of receiving segmented messages. In this case, where the node **20** fails to receive a segmentation support response message from the node **80** in response to the segmentation support test message after a timeout by the timer in the node **20**, only non-segmented messages will be sent from the node **20** to the node **80** thereafter, as shown in step **210**.

As noted above, the nodes **20**, **20'**, **70**, **80**, and **90**, can function as SSPs, STPs, or SCPs. The segmented messages may be SCCP messages, which include a Segment Number Field coded with a value indicating the number of

segmenting messages remaining to be received by the receiving node. The segmentation support test and response messages may be TCAP messages.

It should be noted that the segmentation support test messages described previously may be UDT or XUDT messages. If the receiving node supports message segmentation, then responses to either UDT or XUDT segmentation support test messages will be received in either case. If the receiving nodes do not support segmentation, then no response will be received, and the internal database will be updated accordingly.

Although preferred embodiments of the method and apparatus of the present invention have been illustrated in the accompanying Drawings and described in the foregoing Detailed Description, it will be understood that the invention is not limited to the embodiments disclosed, but is capable of numerous rearrangements, modifications and substitutions without departing from the scope of the invention as set forth and defined by the following claims.